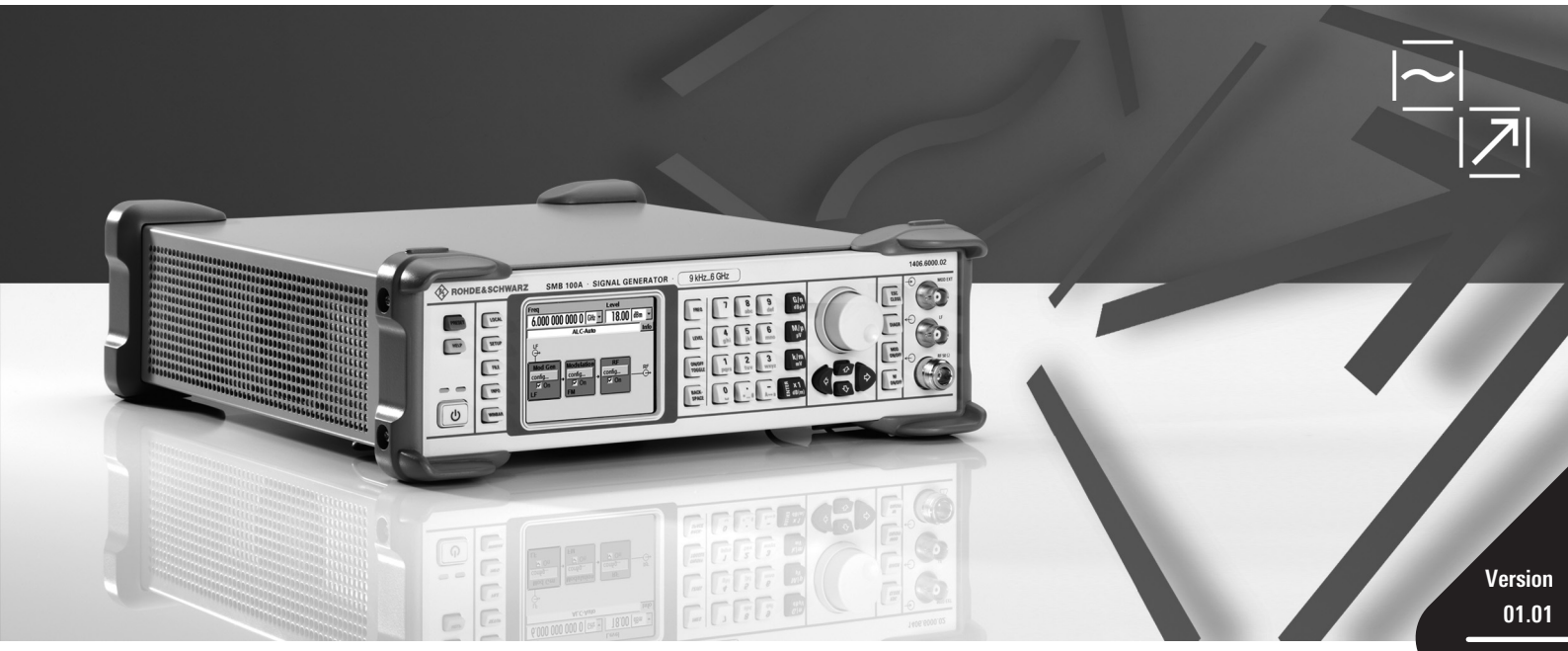


Version
01.01
July
2007

# R&S®SMB100A Signal Generator

Data sheet

ROHDE&SCHWARZ

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# Key features

### Best signal quality in its class

- Low SSB phase noise of typ. –128 dBc (20 kHz carrier offset, 1 GHz carrier frequency, 1 Hz measurement bandwidth)
- Very low SSB phase noise even at low output frequencies (because a new DDS synthesizer is used from 9 kHz to 23.4375 MHz instead of a downconverter)
- Nonharmonics suppression of typ. –85 dBc (>10 kHz carrier offset, carrier frequency <1.5 GHz)
- Low wideband noise of typ. –152 dBc (>10 MHz carrier offset, 1 GHz carrier frequency, 1 Hz measurement bandwidth)
- Harmonics of typ. –30 dBc at the maximum specified output power of +18 dBm

… for high measurement accuracy in a wide variety of applications

### Highest output power in its class

- Specified output power of +18 dBm over the wide frequency range of 1 MHz to 6 GHz
- Typical maximum level of +25 dBm (in overrange) over the entire frequency range up to 6 GHz

… provides power reserve to replace external amplifiers

### On-site servicing as convenient alternative

- Flexible concept allows servicing to be done on site or by a Rohde & Schwarz service center
- Straightforward modular instrument design with only four exchangeable modules ensures short repair times
- Calibrated replacement modules make extensive calibration and adjustment tasks unnecessary
- Built-in selftest of modules supports troubleshooting
- Verification of level accuracy and automatic level correction with a connected power sensor of the R&S NRP family [1]

… ensures low cost of ownership and maximum instrument availability

### All-purpose RF source

- Wide frequency range from 9 kHz to 6 GHz covers the main frequency bands for RF applications
- Integrated frequency, level, and LF sweeps
- All important analog modulations with AM, FM/φM, and pulse modulation supported
- Internal LF generator provides sinewave signals up to 1 MHz as well as squarewave signals up to 20 kHz
- Intuitive user interface with graphical display of the signal flow facilitates operation
- Context-sensitive online help ensures efficient utilization of the instrument

… makes the R&S SMB100A the ideal signal source for a wide variety of applications

### Ideal for production

- Short switchover times for frequency of typ. 1.6 ms and level of typ. 1.2 ms via remote control and <1 ms in the List mode allow high throughput
- High level accuracy and repeatability are the basis of high production yield
- High output power of up to +25 dBm compensates level loss on the way to the DUT
- Wearfree electronic attenuator with overvoltage protection up to 6 GHz as standard ensures long service life even in the case of heavy use in production
- Compact design with only two height units saves rack space
- Remote control via LAN, USB, and GPIB allows easy integration into the test system

… reduces production costs

### Ready for aerospace and defense applications

- Optional pulse modulator offers excellent performance with typ. 90 dB on/off ratio and a rise/fall time of typ. 10 ns
- Flexible pulse generator with minimum pulse width of 20 ns allows the generation of various pulse signals
- Wide temperature range of 0 °C to +55 °C and maximum permissible operating altitude of 4600 m above sea level allow the instrument to be used even under extreme conditions
- Low weight of only 5.3 kg for mobile applications

… expands the range of locations and applications for which the R&S SMB100A can be used

[1] Available as of December 2007 via firmware update.

# Specifications

Specifications apply under the following conditions:

30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed. Data designated ‘overrange’ or ‘underrange’ and data without tolerance limits is not binding.

## RF characteristics

### Frequency

| | | |
|---|---|---|
| Range | R&S®SMB-B101 | 9 kHz to 1.1 GHz |
| | R&S®SMB-B102 | 9 kHz to 2.2 GHz |
| | R&S®SMB-B103 | 9 kHz to 3.2 GHz |
| | R&S®SMB-B106 | 9 kHz to 6 GHz |
| Resolution of setting | | 0.01 Hz |
| Resolution of synthesis | f = 1 GHz | 0.44 µHz |
| Setting time | to within <1 × $10^{-7}$ for f > 200 MHz or <20 Hz for f ≤ 200 MHz | |
| | after IEC/IEEE bus delimiter | <3 ms, typ. 1.6 ms |
| | in ALC OFF mode (S&H) | <7 ms |
| | after trigger pulse in List mode | <1 ms |
| Phase offset | | adjustable in 0.1° steps |

### Frequency sweep

| | | |
|---|---|---|
| Operating modes | digital sweep in discrete steps | automatic, step, single sweep, |
| | | external single, external step, |
| | | manual or external trigger, |
| | | linear or logarithmic spacing |
| Sweep range | | full frequency range |
| Step width | linear | full frequency range |
| | logarithmic | 0.01 % to 100 % per step |
| Dwell time | range | 10 ms to 10 s |
| | resolution | 0.1 ms |

### Reference frequency

| | | |
|---|---|---|
| Aging | after 30 days of uninterrupted operation | <1 × $10^{-6}$/year |
| | with R&S®SMB-B1 option | <1 × $10^{-9}$/day, <1 × $10^{-7}$/year |
| Temperature effect | in temperature range 0 °C to 50 °C | <2 × $10^{-6}$ |
| | with R&S®SMB-B1 option | <1 × $10^{-7}$ |
| Warm-up time | to nominal thermostat temperature (only with R&S®SMB-B1 option) | ≤10 min |
| Output for internal reference signal | frequency (approx. sinewave) | 10 MHz |
| | level | typ. 10 dBm |
| | source impedance | 50 Ω |
| Input for external reference | frequency | 10 MHz |
| | maximum deviation | 3 × $10^{-6}$ |
| | input level, recommended | ≥0 dBm, ≤16 dBm |
| | input impedance | 50 Ω |

## Level

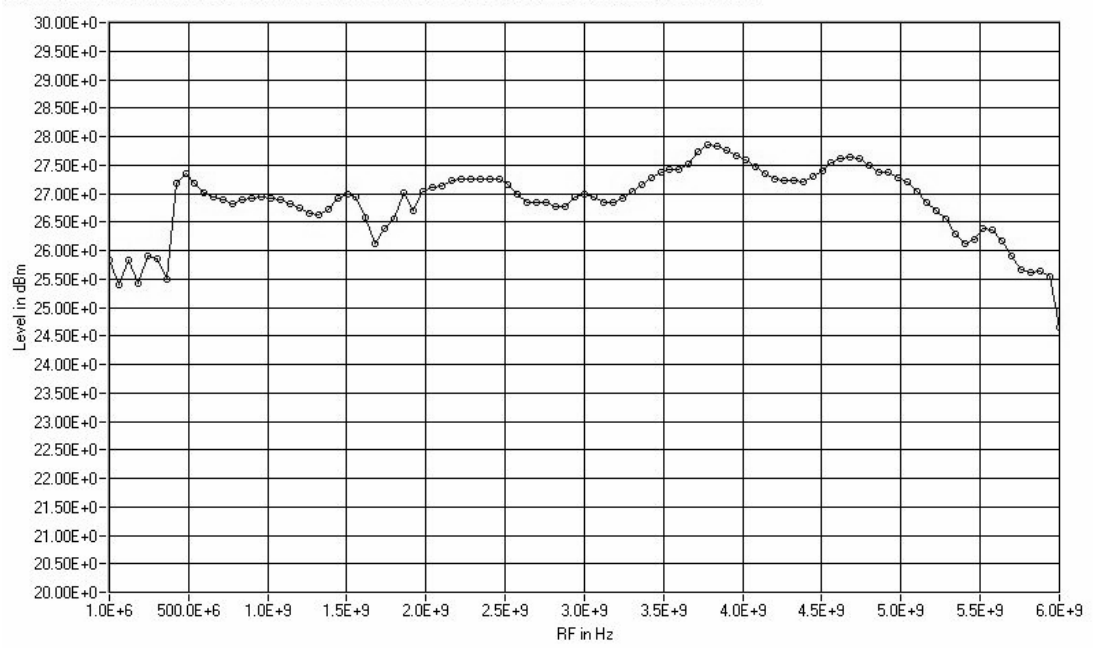
The R&S®SMB100A has two different attenuator modes for level setting:

**AUTO MODE:** In this mode, the attenuator is switched automatically. The output level is specified over the full range from –120 dBm to +13/18 dBm.

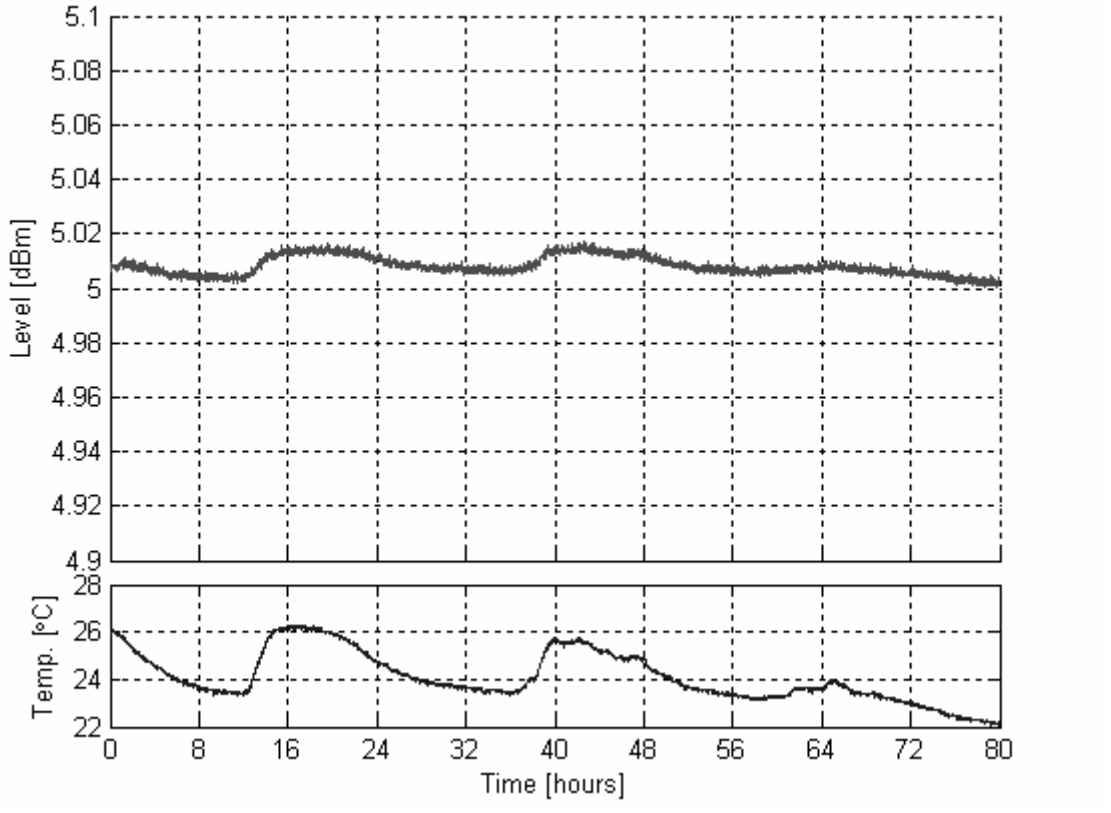
**FIXED MODE:** The level is set without switching the attenuator. The attenuator is fixed to the current setting. If ALC state is ON, level changes are performed without interruption. The maximum attenuation range is limited. With higher attenuation, the spectral purity of the output signal decreases.

| | | |
|---|---|---|
| Setting range | | –145 dBm to +30 dBm |
| Specified level range with R&S®SMB-B101/102/103/106 frequency option | 1 MHz < f ≤ 6 GHz<br>200 kHz < f ≤ 1 MHz | –120 dBm to + 18 dBm (PEP)[2]<br>–120 dBm to + 13 dBm (PEP) |
| Resolution | | 0.01 dB |
| Level uncertainty | ALC state ON, AUTO mode<br>temperature range 18 °C to 33 °C | |
| | 200 kHz < f ≤ 3 GHz | <0.5 dB |
| | f > 3 GHz | <0.9 dB |
| Additional uncertainty with ALC OFF, S&H | This mode is only needed in case of pulse modulation. | <0.5 dB |
| Output impedance VSWR in 50 Ω system | 200 kHz < f ≤ 6 GHz | <1.8 |
| Setting time | after IEC/IEEE bus delimiter,<br>with GUI update stopped,<br>AUTO mode,<br>temperature range 18 °C to 33 °C,<br>to <0.1 dB deviation from final value | |
| | ALC state ON | <2.5 ms, typ. 1.2 ms |
| | ALC state OFF | <7 ms |
| | in List mode after trigger pulse | <1 ms |
| Uninterrupted level setting | FIXED mode, ALC state ON | |
| | setting range | >20 dB |
| Reverse power (from ≥50 Ω source) | maximum permissible RF power in output frequency range of RF path for f > 1 MHz | |
| | 1 MHz < f ≤ 1 GHz | 50 W |
| | 1 GHz < f ≤ 2 GHz | 25 W |
| | 2 GHz < f ≤ 6 GHz | 10 W |
| | maximum permissible DC voltage | 50 V |

[2] PEP = peak envelope power.




*Measured maximum output power versus frequency*



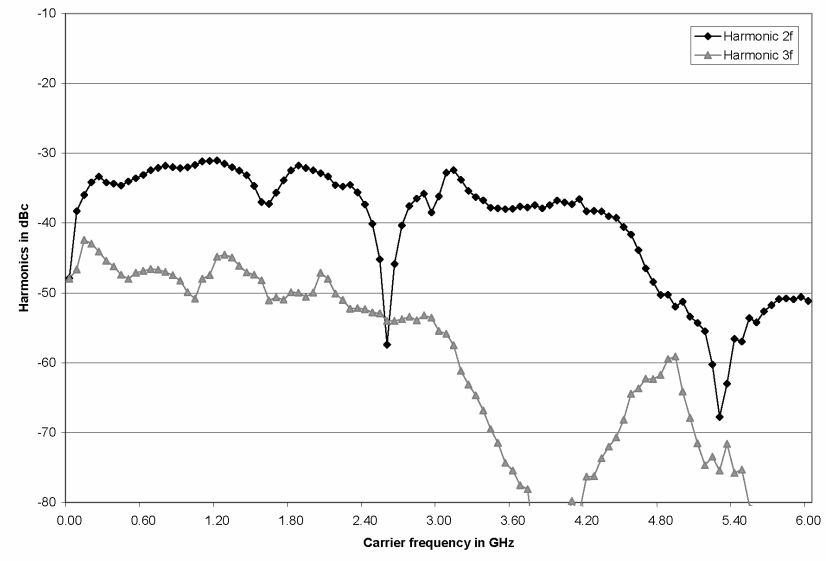

*Measured level repeatability at 3 GHz, 5 dBm, ALC ON*

## Level sweep

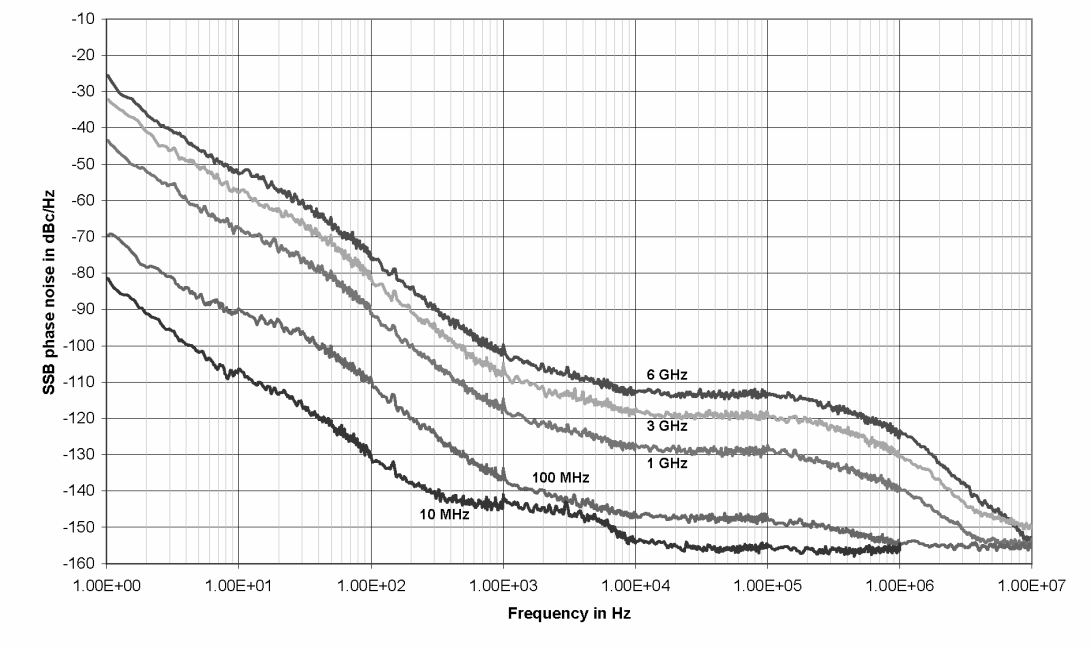
| | | |
|---|---|---|
| Digital sweep in discrete steps | operating modes | automatic, step, single sweep, external single, external step, manual or external trigger, linear spacing |
| | sweep range | full level range |
| | uninterrupted level sweep | 0.01 dB to 20 dB |
| | step width | 0.01 dB to 20 dB per step |

## Spectral purity

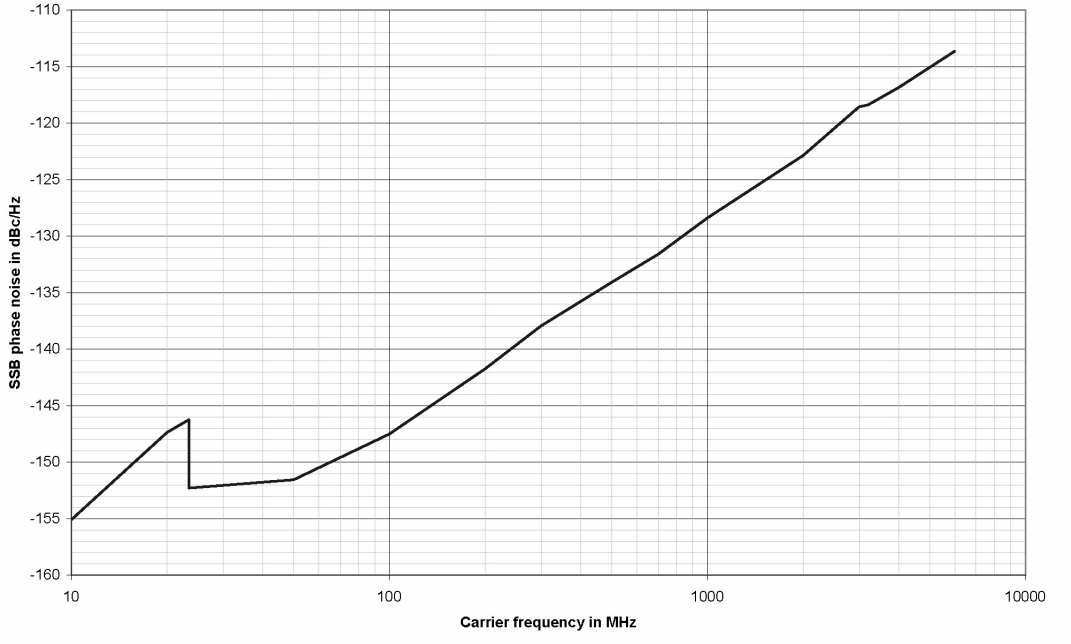
| | | |
|---|---|---|
| Harmonics | f > 1 MHz; CW<br>level ≤ 8 dBm | <–30 dBc |
| Nonharmonics | CW, level >–10 dBm,<br>>10 kHz carrier offset | |
| | f ≤ 1500 MHz | <–70 dBc (typ. < –85 dBc) |
| | 1500 MHz < f ≤ 3 GHz | <–64 dBc (typ. < –79 dBc) |
| | f > 3 GHz | <–58 dBc (typ. < –73 dBc) |
| Wideband noise | attenuator mode AUTO<br>for level > 5 dBm,<br>>10 MHz carrier offset,<br>1 Hz measurement bandwidth, CW | <–142 dBc (typ. –152 dBc) |
| SSB phase noise | 20 kHz carrier offset, 1 Hz measurement bandwidth, CW | |
| | f = 100 MHz | <–141 dBc (typ. –147 dBc) |
| | f = 1 GHz | <–122 dBc (typ. –128 dBc) |
| | f = 2 GHz | <–116 dBc (typ. –122 dBc) |
| | f = 3 GHz | <–112 dBc (typ. –118 dBc) |
| | f = 4 GHz | <–110 dBc (typ. –116 dBc) |
| | f = 6 GHz | <–106 dBc (typ. –112 dBc) |
| RMS jitter | carrier frequency (Cf) = 1 GHz, BW = 1 Hz to 10 MHz,<br>with R&S®SMB-B1 option | typ. 1.1 ps (1.1 mUI) |
| | Cf = 1 GHz, BW = 1 Hz to 10 MHz | typ. 3.9 ps (3.9 mUI) |
| | Cf = 155 MHz, BW = 100 Hz to 1.5 MHz | typ. 83 fs (12,9 µUI) |
| | Cf = 622 MHz, BW = 1 kHz to 5 MHz | typ. 63 fs (39,2 µUI) |
| | Cf = 2.488 GHz, BW = 5 kHz to 15 MHz | typ. 55 fs (137 µUI) |
| Residual FM | RMS value at f = 1 GHz | |
| | 0.3 kHz to 3 kHz, weighted (ITU-T) | <4 Hz |
| | 0.03 kHz to 23 kHz | <10 Hz |
| Residual AM | RMS value (0.03 kHz to 20 kHz) | <0.02 % |




*Measured harmonics at +18 dBm versus frequency*




*Typical SSB phase noise with internal OCXO (R&S®SMB-B1 option)*




*Typical SSB phase noise at 20 kHz offset versus frequency with internal OCXO (R&S®SMB-B1 option)*

## List mode

| | | |
|---|---|---|
| Frequency and level values can be stored in a list and set in an extremely short amount of time. | | |
| Operating modes | | automatic, single sweep, manual or external trigger |
| Max. number of stored settings | | 2000 |
| Dwell time | | 1 ms to 1 s |
| Resolution | | 0.1 ms |
| Setting time | after external trigger | see frequency and level data |

# Analog modulation

## Possible modulation types

Amplitude modulation, frequency modulation, phase modulation, pulse modulation

## Simultaneous modulation

| | Amplitude modulation | Frequency modulation | Phase modulation | Pulse modulation |
|---|---|---|---|---|
| Amplitude modulation | | + | + | (+) |
| Frequency modulation | + | | – | + |
| Phase modulation | + | – | | + |
| Pulse modulation | (+) | + | + | |

+ = compatible, – = incompatible, (+) = compatible with limitations

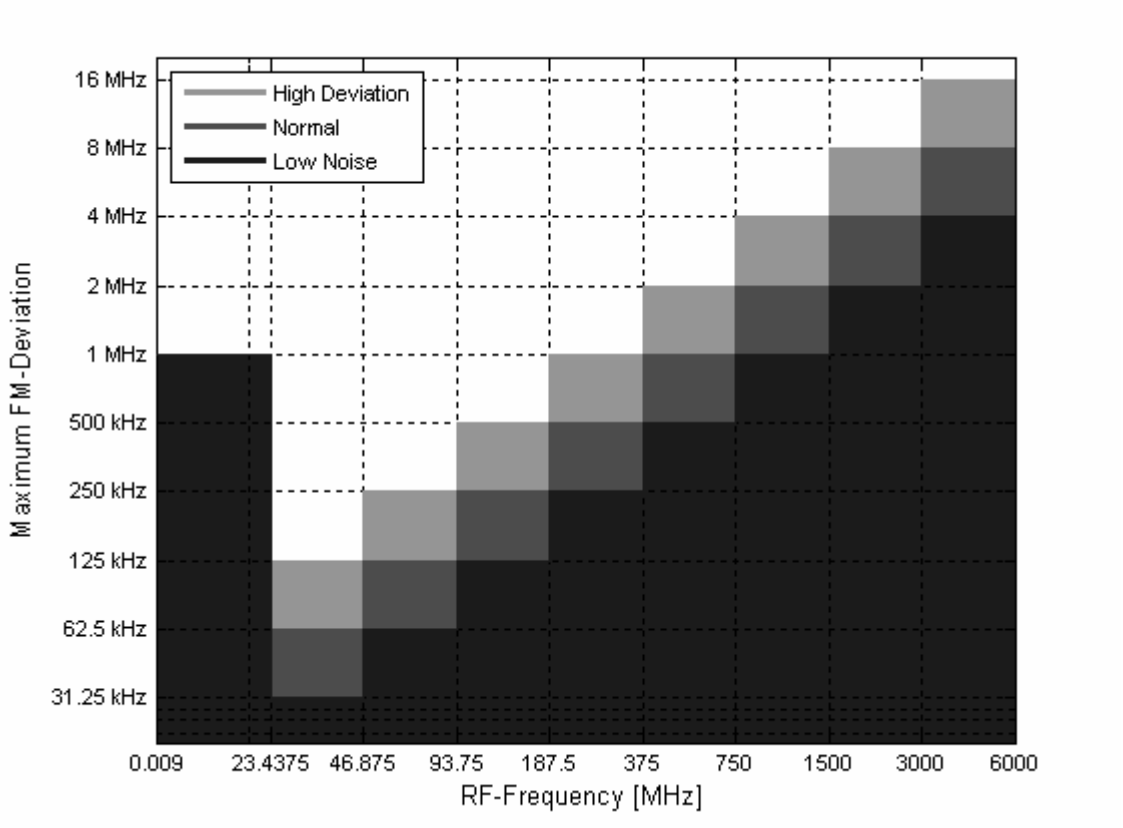
## Amplitude modulation

For f ≥ 100 kHz, attenuator mode AUTO, level (PEP) within specified level range.

| | | |
|---|---|---|
| Operating modes | | internal, external, internal + external, AC/DC |
| Modulation depth | At high levels, modulation is clipped when the maximum PEP is reached. | 0 % to 100 % |
| Resolution | | 0.1 % |
| Setting uncertainty | $f_{mod}$ = 1 kHz and m <80 % | |
| | f ≤ 23.4375 MHz | <(1 % of reading + 1 %) |
| | f > 23.4375 MHz | <(4 % of reading + 1 %) |
| AM distortion | $f_{mod}$ = 1 kHz, f ≤ 23.4375 MHz | |
| | m = 30 % | <0.25 % |
| | m = 80 % | <0.5 % |
| | $f_{mod}$ = 1 kHz, f > 23.4375 MHz | |
| | m = 30 % | < 1.5 % |
| | m = 80 % | < 3 % |
| Modulation frequency response | m = 60 %, up to 50 kHz | <3 dB |
| Synchronous φM at AM | m = 30 %, $f_{mod}$ = 1 kHz, ±peak/2 | <0.2 rad |

## Frequency modulation

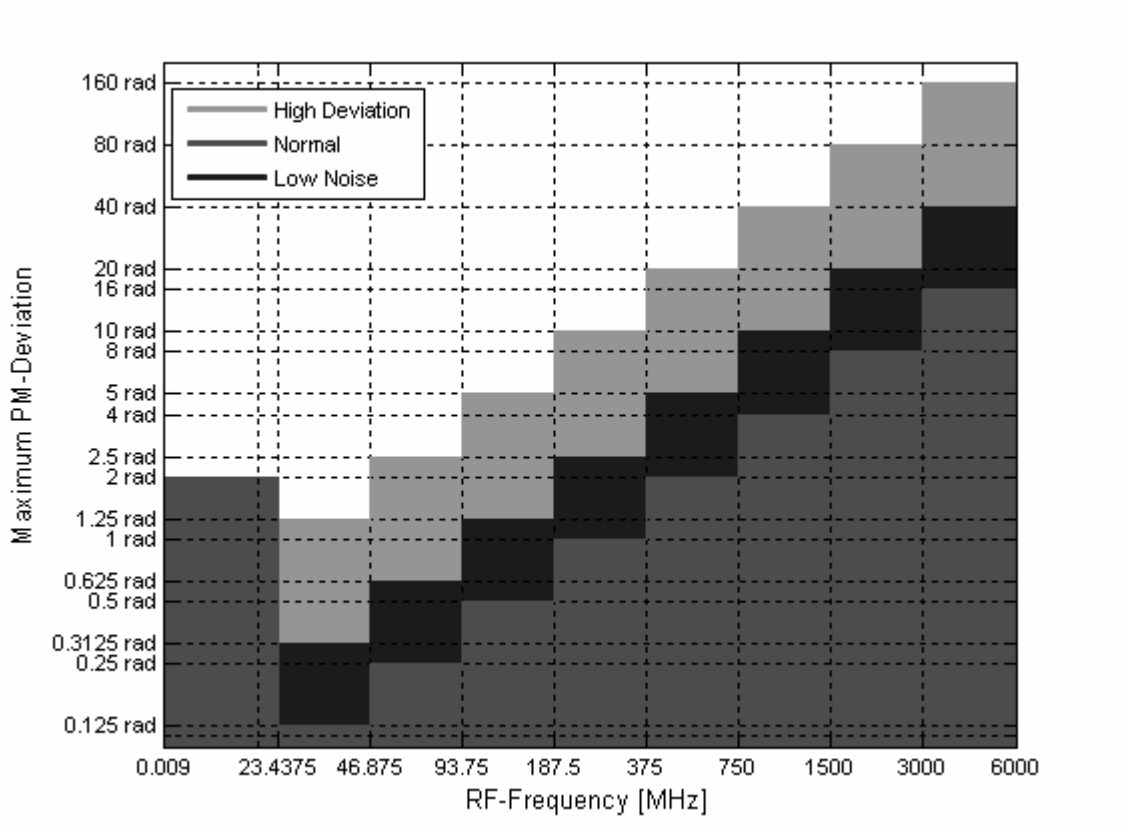
| | | |
|---|---|---|
| FM multiplier for different frequency ranges | f ≤ 23.4375 MHz | rm = 1/4 |
| | 23.4375 MHz < f ≤ 46.875 MHz | rm = 1/32 |
| | 46.875 MHz < f ≤ 93.75 MHz | rm = 1/16 |
| | 93.75 MHz < f ≤ 187.5 MHz | rm = 1/8 |
| | 187.5 MHz < f ≤ 375 MHz | rm = 1/4 |
| | 375 MHz < f ≤ 750 MHz | rm = 1/2 |
| | 750 MHz < f ≤ 1500 MHz | rm = 1 |
| | 1500 MHz < f ≤ 3 GHz | rm = 2 |
| | f > 3 GHz | rm = 4 |
| Operating modes | | internal, external, internal + external, AC/DC<br>FM mode Low Noise<br>FM mode Normal<br>FM mode High Deviation |
| Maximum deviation | f ≤ 23.4375 MHz | 1 MHz |
| | f > 23.4375 MHz | |
| | FM mode Normal | rm × 2 MHz |
| | FM mode Low Noise | rm × 1 MHz |
| | FM mode High Deviation | rm × 4 MHz |
| Resolution | | < 0.02 % of set deviation<br>min. rm × 0.1 Hz |
| Setting uncertainty | $f_{mod}$ = 1 kHz, deviation ≤ rm x 1 MHz | |
| | internal | <(2 % of reading + 20 Hz) |
| | external | <(3 % of reading + 20 Hz) |
| FM distortion | $f_{mod}$ = 2 kHz, deviation = rm × 1 MHz | <0.2 % |
| Modulation frequency response | FM modes Low Noise and High Deviation | |
| | DC/10 Hz to 100 kHz | <3 dB |
| | FM mode Normal | |
| | DC/10 Hz to 500 kHz | <3 dB |
| Synchronous AM | 40 kHz deviation, $f_{mod}$ = 1 kHz, f > 10 MHz | <0.2 % |
| Carrier frequency offset with FM DC | after FM offset calibration | <0.2 % of set deviation |




*FM deviation versus frequency and operating mode*

## Phase modulation

| | | |
|---|---|---|
| φM multiplier for different frequency ranges | f ≤ 23.4375 MHz | rm = 1/4 |
| | 23.4375 MHz < f ≤ 46.875 MHz | rm = 1/32 |
| | 46.875 MHz < f ≤ 93.75 MHz | rm = 1/16 |
| | 93.75 MHz < f ≤ 187.5 MHz | rm = 1/8 |
| | 187.5 MHz < f ≤ 375 MHz | rm = 1/4 |
| | 375 MHz < f ≤ 750 MHz | rm = 1/2 |
| | 750 MHz < f ≤ 1500 MHz | rm = 1 |
| | 1500 MHz < f ≤ 3 GHz | rm = 2 |
| | f > 3 GHz | rm = 4 |
| Operating modes | | internal, external, internal + external, AC/DC<br>φM mode Low Noise<br>φM mode Normal<br>φM mode High Deviation |
| Maximum deviation | f ≤ 23.4375 MHz | 2 rad |
| | f > 23.4375MHz | |
| | φM mode Normal | rm × 4 rad |
| | φM mode Low Noise | rm × 10 rad |
| | φM mode High Deviation | rm × 40 rad |
| Resolution | | < 0.02 % of set deviation,<br>min. rm × 20 µrad |
| Setting uncertainty | $f_{mod}$ = 1 kHz, deviation ≤ half of max. deviation | |
| | internal | <(2 % of reading + 0.003 rad) |
| | external | <(3 % of reading + 0.003 rad) |
| Distortion | $f_{mod}$ = 10 kHz, half of max. deviation | <0.2 % |
| Modulation frequency response | φM modes Low Noise and High Deviation | |
| | DC/10 Hz to 100 kHz | <3 dB |
| | φM mode Normal | |
| | DC/10 Hz to 500 kHz | <3 dB |




*φM deviation versus frequency and operating mode*

### Pulse modulation (R&S®SMB-K22 option)

When pulse modulation is activated, the ALC state of the R&S®SMB100A is automatically changed to ALC OFF (Sample & Hold). In this state, the ALC loop is opened and the output level is set directly. In order to set the correct output level, a sample & hold measurement is performed after each frequency or level setting.

| | | |
|---|---|---|
| Operating modes | | external, internal |
| On/off ratio | | >80 dB |
| Rise/fall time | 10 % to 90 % of RF amplitude | <20 ns, typ. 10 ns |
| Pulse repetition frequency | | 0 Hz to 2.5 MHz |
| Video crosstalk | spectral line of fundamental of 100 kHz squarewave modulation | <–30 dBc |

### Input for external modulation signals

| | | |
|---|---|---|
| Modulation input EXT for AM/FM/φM | input impedance | >100 kΩ |
| | input sensitivity<br>(peak value for set modulation depth or deviation) | 1 V |
| Modulation input PULSE | input level | threshold 1 V |
| | input impedance | >5 kΩ or 50 Ω |
| | polarity | selectable |

## Modulation sources

### Internal modulation generator

| | | |
|---|---|---|
| Waveforms | | sine, square |
| Frequency range | sine<br>square | 0.1 Hz to 1 MHz<br>0.1 Hz to 20 kHz |
| Resolution of setting | | 0.1 Hz |
| Frequency accuracy | | <0.005 Hz + relative deviation of reference frequency |
| Frequency response | sine<br>0.1 Hz to 1 MHz | <1 dB |
| Distortion | sine<br>f < 100 kHz<br>at $R_L$ > 200 Ω, level ($V_{EMF}$) < 1 V | <0.1 % |
| Output voltage | $V_p$ at LF connector, open circuit voltage EMF | 1 mV to 3 V |
| | resolution | 1 mV |
| | setting accuracy at 1 kHz | <(1 % of reading + 1 mV) |
| Output impedance | | 10 Ω |
| Frequency setting time | to within <1 × $10^{-7}$, after IEC/IEEE bus delimiter | <5 ms |
| Sweep | digital sweep in discrete steps | |
| | operating modes | automatic, step, single sweep, external single, external step, manual or external trigger, linear or logarithmic spacing |
| | sweep range | full frequency range |
| | step width (lin) | full frequency range |
| | step width (log) | 0.01 % to 100 % per step |

## Pulse generator (R&S®SMB-K23 option)

| | | |
|---|---|---|
| Operating modes | | automatic, external trigger, external gate, single pulse, double pulse, delayed pulse (external trigger) |
| Active trigger edge | | positive or negative |
| Pulse period | | 100 ns to 85 s |
| Resolution | | 20 ns |
| Pulse width | The pulse width of double pulses can be set independently. | 20 ns to 1 s |
| Resolution | | 20 ns |
| Pulse delay | | 20 ns to 1 s |
| Resolution | | 20 ns |
| Double-pulse spacing | | 20 ns to 1 s |
| Resolution | | 20 ns |
| Uncertainty for pulse timing | generated digitally; ensured by design | relative deviation of reference frequency |
| External trigger | | |
| Delay | | typ. 50 ns |
| Jitter | | <10 ns |
| PULSE/VIDEO output | | LVTTL signal (RL ≥ 50 Ω) |

# General data

## Remote control

| | |
|---|---|
| Systems | IEC/IEEE bus, IEC 60625 (IEEE 488)<br>Ethernet (TC/IP)<br>USB |
| Command set | SCPI 1999.5 |
| Connector | |
| IEC | 24-contact Amphenol |
| Ethernet | Western |
| USB | USB |
| IEC/IEEE bus address | 0 to 30 |
| Interface functions | SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0 |
| LAN interface | 10/100BaseT |

## Operating data

| | | |
|---|---|---|
| Power supply | input voltage range, AC, nominal | 100 V to 240 V (AC) ±10 % |
| | AC supply frequency | 50 Hz to 400 Hz, –5 %/+10 % |
| | power consumption | 250 VA |
| Power factor correction | | in line with EN 61000-3-2 |
| EMC | | in line with EN 55011 class B, EN 61326 |
| Immunity to interfering field strength | | up to 10 V/m |
| Environmental conditions | operating temperature range | 0 °C to 55 °C<br>in line with EN 60068-2-1, EN 60068-2-2 |
| | storage temperature range | –40 °C to +71 °C |
| | climatic resistance,<br>+40 °C/95 % rel. humidity | in line with EN 60068-2-3 |
| | operating altitude | up to 4600 m |
| Mechanical resistance | vibration, sinusoidal | 5 Hz to 150 Hz,<br>max. 2 g at 55 Hz,<br>max. 0.5 g at 55 Hz to 150 Hz,<br>in line with EN 60068-2-6 |
| | vibration, random | 10 Hz to 300 Hz, acceleration 1.2 g (rms)<br>in line with EN 60068-2-64 |
| | shock | 40 g shock spectrum<br>in line with EN 60068-2-27,<br>MIL-STD-810E |
| Electrical safety | | in line with IEC 61010-1, EN 61010-1,<br>CAN/CSA-C22.2 No. 61010-1-04,<br>UL 61010-1 |
| Approvals | | VDE-GS, $_{C}$CSA$_{US}$ |
| Dimensions (W × H × D) | | 344 mm x 112 mm x 368 mm<br>(13.54 in × 4.41 in × 14.49 in) |
| Weight | when fully equipped | 5.3 kg (11.7 lb) |
| Recommended calibration interval | | 3 years |

# Ordering information

| Designation | Type | Order No. |
|---|---|---|
| Signal Generator3 | R&S®SMB100A | 1406.6000.02 |
| Including power cable, Quick Start Guide, and CD-ROM (with operating and service manual) | | |
| **Options** | | |
| RF Path | | |
| 9 kHz to 1.1 GHz | R&S®SMB-B101 | 1407.2509.02 |
| 9 kHz to 2.2 GHz | R&S®SMB-B102 | 1407.2609.02 |
| 9 kHz to 3.2 GHz | R&S®SMB-B103 | 1407.2709.02 |
| 9 kHz to 6 GHz | R&S®SMB-B106 | 1407.2909.02 |
| Reference Oscillator OCXO | R&S®SMB-B1 | 1407.3005.02 |
| Pulse Modulator | R&S®SMB-K22 | 1407.3770.02 |
| Pulse Generator | R&S®SMB-K23 | 1407.3786.02 |
| **Recommended extras** | | |
| Hardcopy manuals (in English, UK) | | 1407.0806.32 |
| Hardcopy manuals (in English, US) | | 1407.0806.39 |
| 19" Rack Adapter | R&S®ZZA-S234 | 1109.4493.00 |
| Power Sensor 9 kHz to 6 GHz | R&S®NRP-Z92 | 1171.7005.42 |
| Keyboard with USB Interface (US character set) | R&S®PSL-Z2 | 1157.6870.04 |
| Mouse with USB Interface, optical | R&S®PSL-Z10 | 1157.7060.03 |

# License information

The firmware of this device contains open source software. Details as well as license agreements can be found in release notes and operating manual.

[3] The base unit must be ordered together with an R&S®SMB-B101/R&S®SMB-B102/R&S®SMB-B103/R&S®SMB-B106 frequency option.

For product brochure, see PD 5213.8396.12
and www.rohde-schwarz.com
(search term: SMB100A)

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